Claims

1   1.   A method of calculating a modification of a geometrical shape, comprising the steps of:

2   defining on a multi-dimensional space an array of values representing a geometrical

3   shape;

4   selecting a modification function that represents a desired modification to be applied to

5   the geometrical shape;

6   applying an inverse function of the modification function to the array of values to produce

7   a modified array; and

8   deducing from the modified array a modification of the geometrical shape that would

9   result from a direct application of the modification function to the array.

10   2.   The method of claim 1, further comprising the step of applying the deduced modification

12   to the array.

13   3.   The method of claim 1, further comprising displaying to a user the modification of the

    geometrical shape that would result from a direct application of the modification function to the

    array.

1   4.   The method of claim 1, wherein the step of deducing from the modified array a

2   modification further comprises the steps of:

3   retrieving an array value from the modified array; and

4   applying the array value from the modified array at a location in the array representing the

5   geometrical shape.

1   5.   The method of claim 1, wherein the modification function comprises a soft-edged

2   deformation.

1   6.   The method of claim 1, wherein the modification function is applied from a selected one

2   of a first side and a second side of the geometrical shape.

1   7.   The method of claim 1, further comprising applying the modification function by

2   manipulation of a virtual tool.

1   8.   The method of claim 7, wherein the geometrical shape is displaced away from the virtual

2   tool.

1   9.   The method of claim 7, wherein the geometrical shape is displaced toward the virtual

2   tool.

1   10.   The method of claim 9, wherein the modification of the geometrical shape is substantially

2   a convex hump.

1   11.   The method of claim 9, wherein the modification of the geometrical shape is substantially

2   a concave spiked protuberance.

1   12.   The method of claim 1, wherein the modification function comprises a force field

2   consistent with a tool of arbitrary shape.

1   13.   The method of claim 1, wherein the modification function comprises translational

2   displacement.

1   14.   The method of claim 1, wherein the modification function comprises rotational

2   displacement.

1   15.   The method of claim 1, wherein the modification function comprises a selected one of a

2   displacement function, a smoothing function, a warping function, a volumetric interference, an

3   areal interference, a result of a simulation, a data re-fitting, and a force.

1   16.   The method of claim 1, wherein the modification function is represented as a non-linear

2   mathematical function.

1   17.   The method of claim 1, further comprising the steps of:

2   selecting a second modification function;

3   applying an inverse function of the second modification function to the modified array to

4   produce a twice-modified array; and

5   deducing from the twice-modified array a modification of the geometrical shape that

6   would result from an application of the modification function to the array followed by

7   an application of the second modification function to the once-modified array.

1   18.   The method of claim 1, wherein the modification comprises applying a constraint so as to
2   control a magnitude of a change of the geometrical shape.

1   19.   The method of claim 18, wherein applying the constraint prevents at least one point of the
2   geometrical shape from moving in response to the application of the inverse function of the
3   modification function.

1   20.   The method of claim 1, wherein the modification comprises applying a surface texture to
2   the geometrical shape.

1   21.   A system for calculating a modification of a geometrical shape, comprising:

2   a generation module that defines on a multi-dimensional space an array of values

3   representing a geometrical shape;

4   a selection module that provides a modification function representing a desired

5   modification to be applied to the geometrical shape;

6   a transformation module that applies an inverse function of the modification function to

7   the array of values to produce a modified array; and

8   a calculation module that deduces from the modified array a modification of the

9   geometrical shape that would result from a direct application of the modification

10   function to the array.

1   22.   The system of claim 21, further comprising a modification module that applies the

2   deduced modification to the array.

1   23.   The system of claim 21, further comprising a display module that displays to a user the

2   modification of the geometrical shape that would result from a direct application of the

3   modification function to the array.

1   24.   The system of claim 21, wherein the calculation module further comprises:

2   a module that retrieves an array value from the modified array; and

3   a module that applies the array value from the modified array at a location in the array

4   representing the geometrical shape.

25.   The system of claim 21, wherein the modification function comprises a soft-edged

2   deformation.

26.   The system of claim 21, wherein the modification function is applied from a selected one

2   of a first side and a second side of the geometrical shape.

1   27.   The system of claim 21, further comprising a module that applies the modification

2   function by manipulation of a virtual tool.

1   28.   The system of claim 27, wherein manipulation of a virtual tool displaces the geometrical

2   shape away from the virtual tool.

1   29.   The system of claim 27, wherein manipulation of a virtual tool displaces the geometrical

2   shape toward the virtual tool.

1   30.   The system of claim 29, wherein the modification of the geometrical shape is

2   substantially a convex hump.

1   31.   The system of claim 29, wherein the modification of the geometrical shape is

2   substantially a concave spiked protuberance.

1   32.   The system of claim 21, wherein the modification function comprises a force field

2   consistent with a tool of arbitrary shape.

1   33.   The system of claim 21, wherein the modification function comprises translational

2   displacement.

1   34.   The system of claim 21, wherein the modification function comprises rotational

2   displacement.

1   35.   The system of claim 21, wherein the modification function comprises a selected one of a

2   displacement function, a smoothing function, a warping function, a volumetric interference, an

3   areal interference, a result of a simulation, a data re-fitting, and a force.

1   36.   The system of claim 21, wherein the modification function is represented as a non-linear

2   mathematical function.

1   37.   The system of claim 21, further comprising:

2   a selection module that selects a second modification function;

3   a transformation module that applies an inverse function of the second modification

4   function to the modified array to produce a twice-modified array; and

5   a calculation module that deduces from the twice-modified array a modification of the

6   geometrical shape that would result from an application of the modification function to

7   the array followed by an application of the second modification function to the once-

8   modified array.

1   38.   The system of claim 21, wherein the modification comprises applying a constraint so as

2   to control a magnitude of a change of the geometrical shape.

1   39.   The system of claim 38, wherein the module that applies the constraint prevents at least

2   one point of the geometrical shape from moving in response to the application of the inverse

3   function of the modification function.

1   40.   The system of claim 21, wherein the modification comprises applying a surface texture to

2   the geometrical shape.